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NOTES ON GEOGRAPHIC DISTRIBUTION

First records of three species of *Lasiurus* Gray, 1831 (Chiroptera, Vespertilionidae) in Bolivia

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Abstract. Insectivorous bats of the family Vespertilionidae have been grouped into eight tribes, with Lasiurini showing an extensive distribution in South America. In Bolivia, three species of lasiurine bats have been reported: *Lasiurus blossevillii* (Lesson & Garnot, 1826), *L. ega* (Gervais, 1856), and *L. villosissimus* (É. Geoffroy St. -Hilaire, 1806). The morphological analyses of specimens of this genus deposited in Bolivian scientific collections and comparisons with specimens from other countries (including holotypes) prompt us to report the first records of three species: *Lasiurus atratus* Handley 1996, *L. castaneus* Handley 1960, and *L. egregius* (Peters, 1870) in Bolivia, expanding their known geographic ranges to the southwestern part of the Amazon.

Key words. Bats, new records, Pando, Distribution, Amazonia

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INTRODUCTION

Knowledge of the diversity, distribution, and biology of New World bats belonging to the family Vespertilionidae Gray, 1821 has increased substantially over the last few years (e.g. Baird et al. 2015, 2017, 2021; Novaes et al. 2018; Moratelli et al. 2019a, 2019b, 2019c). In the Western Hemisphere, Vespertilionidae includes four tribes, of which Lasiurini is known to have a wide geographical range, from sea level to 3,836 m, in varied ecological conditions (Ramírez-Chaves et al. 2023). Currently, 20 species are recognized as representatives of this tribe (Simmons and Cirranello 2024), all traditionally included in the genus *Lasiurus* Gray, 1831 (Gardner and Handley 2008). The alternative placement of these species in three genera—*Aeorestes*, *Dasypterus*, and *Lasiurus*—has also been proposed (Baird et al. 2015, 2017, 2021), but we treat these names here as subgenera of *Lasiurus* (Novaes et al. 2018; Teta 2019; Mammal Diversity Database 2024; Simmons and Cirranello 2024). Ten of the 20 species of *Lasiurus* are distributed in South America: *Lasiurus arequipae* Málaga, Díaz, Arias & Medina, 2020; *L. atratus* Handley, 1996; *L. blossevillii* (Lesson & Garnot, 1826); *L. castaneus* Handley, 1960; *L. ebenus* Fazzolari-Correa, 1994; *L. ega* (Gervais, 1856); *L. egregius* (Peters, 1870), *L. frantzii* (Peters, 1870); *L. varius* Poeppig, 1835; and *L. villosissimus* (É. Geoffroy St. -Hilaire, 1806). Only three of them are listed as part of the Bolivian fauna: *L. blossevillii*, *L. ega*, and *L. villosissimus* (see Anderson et al. 1982; Díaz et al. 2021; Poma-Urey et al. 2023; Ramírez-Chaves et al. 2023; Rojas-Herrera et al. 2023).

Based on the pioneer work of Handley (1960, 1996) and Barquez et al. (1999), which has been subsequently supported by other authors (e.g. López-Baucells et al. 2014; Cláudio et al. 2018; Moratelli et al. 2019c; Málaga et al. 2020; Díaz et al. 2023; Ossa et al. 2019), it is generally accepted that South American species of Lasiurini can be separated into two large groups, depending on wing color: those with entirely black wings (*L. atratus*, *L. castaneus*, *L. ebenus*, and *L. varius*) and those with light or dark wings with pale-orange or whitish-mottled paths on both sides of the forearms, metacarpals, and digits (*L. arequipae*, *L. blossevillii*, *L. frantzii*, *L. egregius*, *L. villosissimus*, and *L. ega*). Herein, we used this criterion, additional morphological evidence (cranial features, size, color and percentage of the dorsal coat bands, proportion of hair on the uropatagium, and presence of light patches on the shoulders; Handley 1960, 1996; Málaga et al. 2020), and comparisons with museum specimens, including type material, to verify and update the identities of specimens of *Lasiurus* in Bolivian natural history collections. In the process, we confirm the presence of three new species of *Lasiurus* (*Lasiurus atratus*, *L. castaneus*, and *L. egregius*) in Bolivia. The

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new records substantially increase the southern distributions of these three taxa and suggest that their perceived rarity is likely a collecting artifact.

METHODS

As part of a taxonomic analysis of a series of bats deposited in mammal collections of Bolivia, we reviewed a total of 49 specimens of Lasiurini deposited in the following institutions: Museo Noel Kempff Mercado (MNKM, Santa Cruz de la Sierra), Colección Boliviana de Fauna (CBF, La Paz), Museo de Historia Natural Alcide d'Orbigny (Cochabamba), and Centro de Biodiversidad y Genética (Cochabamba). Morphological comparisons were also conducted by JOG at the mammal section of the Museo de la Estación Biológica de Rancho Grande (EBRG, Aragua, Venezuela), where specimens of *L. atratus* are housed. Similarly, we compared our specimens with photographs of the holotypes of *L. castaneus* (National Museum of Natural History, USNM 310263) and *L. atratus* (Field Museum Natural History, FMNH 93235), and additional specimens of *L. castaneus* from Universidad de Costa Rica (UCR).

Considering that measurements traits have been used for taxonomic identification, we obtained the following external measurements from specimen's labels: total length (ToL), tail length (TL), hindfoot length (HF), ear length (EL), forearm length (FA), and weight (W); when possible, FA was measured directly from the specimens. Additionally, we took seven cranial measurements, whose values were taken to the nearest 0.1 mm (Barquez et al. 1999): greatest length of skull (GLS), zygomatic breadth (ZB), postorbital breadth (PB), braincase breadth (BB), breadth across canines (CC), maxillary toothrow length (MTL), and breadth across molars (M-M).

RESULTS

Our analyses indicated that three of the 34 studied specimens of *Lasiurus* from Bolivia exhibited characters that do not conform with those of species known for this country, but instead correspond to the following taxa: *Lasiurus atratus* (♀ CBF 1425), *L. castaneus* (♀ CBF 1416), and *L. egregius* (♂ CBF 1423). Each of these specimens represents new record for its species in Bolivia. CBF 1425 and CBF 1416 were previously identified as *L. blossevillii*, while CBF 1423 was formerly identified as *L. ega* in the literature (Aguirre and de Urioste 1994; Anderson 1997). Geographical and morphological data on these bats are as follow:

Lasiurus atratus Handley, 1996

Figure 1

New record. BOLIVIA – Pando • 15 km NW of Puerto Camacho, Arroyo Hermoso; −11.2167, −067.7000; 195 m elev.; 13.X.1991; Luis Aguirre and Roberto de Urioste leg.; habitat: secondary forest with patches of primary vegetation, with heavy rubber and chestnut extractive industry; 1 ♀ adult, CBF 1425 (Figures 1E–H, 2).

Other material examined. VENEZUELA – Bolivar • Reserva Forestal de Imataca, Unidad V, 50 km SE of Tumeremo, carretera Tumeremo-Bochinche; −07.5867, −061.0575; 180 m elev.; 10–16.IX.1990; José Ochoa leg.; 2 ♀ adult, EBRG 19956, EBRG 20425 (Figure 1A–D) • same locality; 13.X.1991; Daniel Lew leg.; 1 ♀ adult, EBRG 19961. 6–7.XI.1991; Daniel Lew leg.; 2 ♀, 1 ♂ adult, EBRG 19962, 19964. 1–2.II.1992; José Ochoa leg.; 2 ♀ adult, EBRG 19957–58 • same locality; 27.VI.1993; José Ochoa leg.; 2 ♀ adult, EBRG 19959–19960.

SURINAME • Kaiserberg Airstrip, Zuid River; 3.1167, −056.4500; 278 m elev.; 10.II.1961; H.A. Beatty leg.; holotype 1 ♂ adult, FMNH 93235.

Identification. *Lasiurus atratus* is a medium-sized bat, with an average forearm length in males and females of 45.2 and 46.4 mm, respectively (Handley 1996; Lim et al. 1999; Table 1). The wings are entirely black (Figure 1A, I); the dorsal coloration is bright reddish, tricolored, with the basal band black (1.7 mm), the middle band yellowish (wider than the other two bands, 4.4 mm), and the distal band reddish (3.1 mm) (Figure 1B, J). It also has a white humeral patch in the shoulder region that is described as prominent by Handley (1996), but is barely visible in the holotype (Figure 1D), likely due to its preparation as a skin and skull specimen. The uropatagium is covered by short hairs up to the distal edge (Figure 1C, K), although the Venezuelan and Bolivian specimens exhibit more prominent hairs in the region of the uropatagium compared to the holotype (Handley 1996; Moratelli et al. 2019a). The ventral hairs are bicolored, with a dark brown or black base and whitish tips (Figure 1D, H, L). The craniodental characters of *L. atratus* are similar to those of other small to medium-sized species in the genus (e.g. *L. blossevillii*, *L. castaneus*, and *L. frantzii*).

The Bolivian specimen (CBF 1425) has a forearm length of 45.0 mm and GLS of 13.7 mm, matching with the range of variation in the series of *L. atratus* specimens collected in Venezuela. Additionally, the coloration of the dorsal (including the proportion of the bands) and ventral hairs, the humeral spot, and the distribution of hairs on the dorsum of the uropatagium (Figure 1) are similar to the patterns found in the Venezuelan specimens.

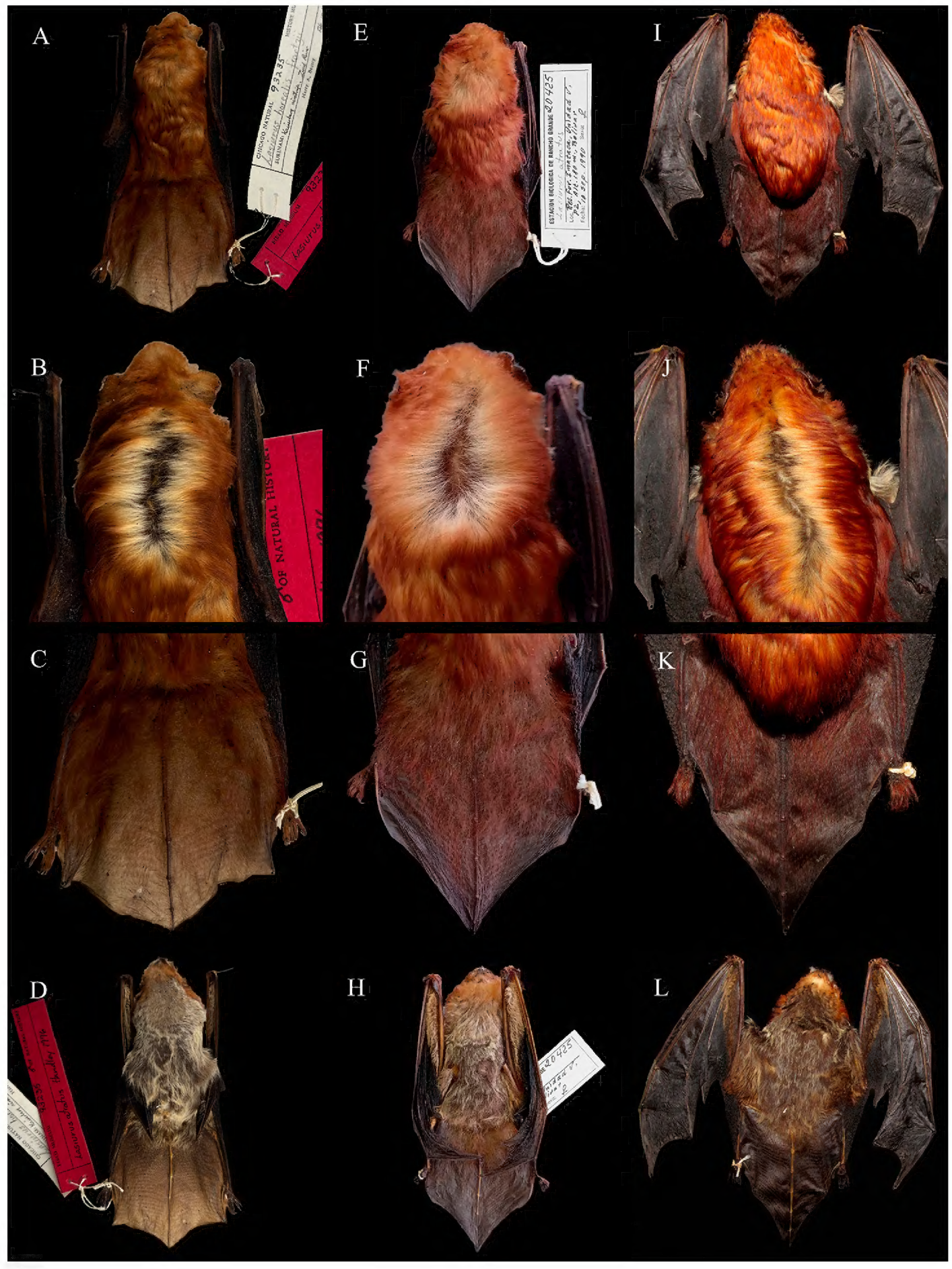

Figure 1. Dorsal and ventral views of specimens of *Lasiurus atratus* from three countries. **A–D.** Southern Suriname (Holotype, FMNH 93235). **E–H.** Venezuela (EBRG 20425). **I–L.** Bolivia (CBF 1425). Note the reddish color of the dorsal hair and the median band wider than the ends, as well as the presence of relatively sparse hairs on the entire surface of the uropatagium and whitish-yellowish color on the distal part of the ventral fur. All these characteristics were noted by Handley (1996) in the original description of the species.

The dental formula of *L. atratus* is 1/3, 1/1, 2/2, 3/3 × 2 = 32, like most of its congeners (*L. arequipae*, *L. blossevillii*, *L. castaneus*, *L. ebenus*, *L. frantzii*, *L. varius*, and *L. villosissimus*). In contrast, *L. egregius* and *L. ega* exhibit the following dental formula: 1/3, 1/1, 1/2, 3/3 × 2 = 30 (Table 2). Based on the forearm length (45.2–46.4 mm), *L. atratus* is similar to *L. arequipae*, *L. ebenus*, and *L. ega*, but it is smaller than *L. egregius* (FA > 47. 6 mm) and *L. villosissimus* (FA > 50.0 mm). *Lasiurus atratus* is larger than *L. blossevillii* (FA < 42 mm), *L. castaneus* (FA < 45.4 mm), *L. frantzii* (FA < 42.9 mm), and *L. varius* (FA < 42 mm) (Table 2).

The number of bands in the dorsal pelage of *L. atratus* (three) is present in most *Lasiurus* species, with the exception of *L. villosissimus* (four) and *L. blossevillii* (five). Among the tricolored species, *L. atratus* is similar to *L. frantzii*, *L. varius*, and *L. egregius*, in presenting a reddish terminal band, whereas in the other species this band can be yellowish (*L. ega*), chestnut (*L. castaneus*), dark brown (*L. arequipae*), or black (*L. ebenus*). *Lasiurus villosissimus* and *L. blossevillii* also differ from *L. atratus* in this respect, presenting a dorsal pelage with frosted tips (Table 2).

Regarding the length of the dorsal hairs and the proportions occupied by their bands, in *L. atratus* the dorsal coat is ~9 mm, where the central band is wider than the adjacent ones. Other species of the genus with tricolored dorsal fur and a wider central band, but with longer hairs, are *L. frantzii* (~12 mm), *L. varius* (~10 mm), *L. egregius* (~13 mm), and *L. ega* (~13 mm). In a second group, the length of dorsal hairs is equal to or less than the value indicated for *L. atratus* showing the same number of bands, but with the middle band similar in extension to the basal and distal bands: *L. castaneus* (~9 mm) and *L. ebenus* (~6.5 mm). Other *Lasiurus* show between 4 and 5 color bands in the dorsal hairs, as *L. villosissimus*, with a dorsal fur

Table 1. External and cranial measurements (mm) of *Lasiurus atratus* (Handley 1996; Lim et al. 1999), *Lasiurus castaneus* (Handley 1960; Dinerstein 1985; Villalobos-Chaves and Dick 2014), and *L. egregius* (Carter and Dolan 1978; Williams et al. 1990; Mora 2012; López-Baucells et al. 2014; Carvalho et al. 2019). Data include: mean, standard deviation, and number of specimens (in parentheses).

	L. atratus			***L. castaneus***			***L. egregius***		
	Male	**Female**	**CBF 1425 (♀)**	**Male**	**Female**	**CBF 1416 (♀)**	**Male**	**Female**	**CBF 1423 (♂)**
ToL	—	114.33 ± 2.08 (3)	113.00	102.63 ± 0.09 (2)	108.16 ± 5.00 (3)	98.00	121.80 ± 18.66 (2)	118.95 ± 8.11 (4)	123.00
TL	—	54.00 ± 2.64 (3)	49.00	48.50 ± 2.12 (2)	48.5 ± 0.50 (3)	47.00	55.85 ± 12.94 (2)	57.10 ± 3.63 (4)	57.00
HF	10.66 ± 0.57 (3)	10.44 ± 0.55 (5)	8.56	8.24 ± 1.02 (2)	9.40 ± 2.11 (3)	9.00	9.60 ± 1.97 (2)	9.17 ± 1.44 (4)	8.00
EL	13.00 ± 0.00 (2)	13.00 ± 0.00 (3)	13.00	11.46 ± 0.07 (2)	14.23 ± 3.35 (3)	13.00	15.56 ± 2.20 (2)	15.17 ± 1.96 (4)	17.00
FA	45.20 ± 0.78 (7)	46.44 ± 1.39 (11)	45.00	44.00 ± 1.00 (3)	45.43 ± 0.60 (3)	43.50	49.23 ± 1.80 (3)	48.70 ± 1.66 (8)	47.62
W	11.00 ± 0.00 (2)	12.00 ± 0.00 (2)	12.00	11.93 ± 0.40 (3)	14.3 ± 3.81 (2)	9.00	17.00 ± 0.00 (1)	15.50 ± 0.71 (2)	—
GLS	12.93 ± 0.61 (6)	13.43 ± 0.82 (7)	13.70	12.74 ± 0.09 (2)	13.00 ± 0.29 (3)	12.80	17.30 ± 0.00 (1)	16.40 ± 0.32 (4)	17.93
ZB	9.57 ± 0.26 (6)	9.91 ± 0.19 (7)	10.16	9.90 ± 0.00 (2)	10.02 ± 0.39 (3)	—	—	11.90 ± 0.18 (4)	11.53
PB	4.36 ± 0.28 (6)	4.33 ± 0.13 (7)	4.27	4.51 ± 0.14 (2)	4.34 ± 0.16 (3)	4.21	—	4.80 ± 0.20 (3)	4.66
BB	7.76 ± 0.21 (6)	7.87 ± 0.19 (6)	8.07	7.87 ± 0.02 (2)	7.76 ± 0.23 (2)	8.00	—	8.60 ± 0.66 (4)	9.13
CC	5.32 ± 0.19 (5)	5.46 ± 0.15 (5)	5.79	5.63 ± 0.02 (2)	5.69 ± 0.01 (3)	5.22	—	5.9 ± 0.70 (2)	6
MTL	4.65 ± 0.21 (6)	4.87 ± 0.09 (7)	4.77	4.71 ± 0.09 (2)	4.51 ± 0.27 (3)	4.69	—	5.93 ± 0.15 (3)	6.25
M-M	6.43 ± 0.26 (6)	6.69 ± 0.15 (7)	6.76	6.70 ± 0.06 (2)	6.81 ±0.16 (3)	6.7	—	7.75 ± 0.07 (2)	8.08

Table 2. Somatic and cranial variables corresponding to the species of the tribe Lasiurini recorded in South America.

Characters	*L. atratus*	*L. castaneus*	*L. ebenus*	*L. varius*	*L. arequipae*	*L. blossevillii*	*L. frantzii*	*L. villosissimus*	*L. egregius*	*L. ega*
Dental formula	1/3, 1/1, 2/2, 3/3 × 2 = 32								1/3, 1/1, 1/2, 3/3 × 2 = 30	
Wing color	Completely black				Mottled pale Orange, only in *L. egregius* do the pale zones include the thumb, index and middle digits					
White humeral spot	Present	Present	Missing	Present	Present	Missing	Present	Missing	Missing	Missing
FA (mm)	45–46	44–45	~45	<42	46–47	<42	<42	>50	>47	43–51
Dorsal color	Bright reddish	Chestnut	Black	Reddish	Reddish frost	Reddish frost	Reddish	Frosted yellow	Reddish	Yellowish
Pelage over the uropatagium	Up to or near edge of uropatagium	Covers ¾	Covers ⅓–½	Goes beyond distal border	Covers 100%	Densely covered		Covers 100%	Covers ½	Covers ½
Dorsal hair length (mm)	~9	9	6.5	~10	—	9	~11.6	6.8	~13	~13
Dorsal hair bands	3	3	3	3	3	5	3	4	3	3
Hair band color	Black yellow reddish	Black yellow chestnut	Black dark brown black	Black Yellow reddish	Black yellow Dark brown	Black yellow Cinnamon Reddish Off-white	Black yellow Reddish	Black yellow Dark brown Off-white	Black pale yellow reddish	Brown Brown-Yellow Yellowish
Middle band in dorsal hair	Wider than basal and distal	Narrow, same width as distal and basal	—	—	—			—	Wider than basal and distal	—
Angle of the coronoid process	—	—	—	—	—			—	20°	40°

~7 mm, and a tetracolored pattern where the subbasal band is wider than the remaining bands. In *L. blossevillii* these hairs measure up to 9 mm, presenting five bands; the second is the widest. With respect to *L. arequipae*, a series of characters separate this taxon from *L. atratus*, which are indicated in Table 2.

Lasiurus atratus also presents sparse hairs on the dorsal side of the uropatagium, with these hairs reaching the distal edge but without protruding from it. A similar pattern occurs in *L. arequipae, L. blossevillii*, and *L. villosissimus*, contrasting with the condition in *L. ebenus* and *L. castaneus*, both presenting the proximal 2/3 of the uropatagium abundantly haired and the distal third naked. *Lasiurus frantzii* has hairs up to the middle of the uropatagium, and *L. varius* is the only species with hairs that notably exceed the edge of the uropatagium (Table 2). In relation to the patch of lighter hairs on the shoulders, this characteristic is present in *L. atratus*, *L. arequipae*, *L. castaneus*, *L. frantzii*, and *L. varius*, and lacking in *L. blossevillii*, *L. ebenus*, *L. ega*, *L. egregius*, and *L. villosissimus* (Table 2). Further, *L. atratus*, *L. ebenus*, *L. castaneus*, and *L. varius* present entirely black wings, whereas *L. arequipae*, *L. blossevillii*, *L. ega*, *L. frantzii*, and *L. villosissimus* exhibit black or dark brown wings mottled with orange or whitish color around the forewings, metacarpals and digits, and *L. egregius* has mottled thumb, index, and middle fingers.

Taxonomic remarks. One specimen of *L. atratus* from Guyana deposited in the Royal Ontario Museum (ROM 107228) has a remarkably large forearm length (49 mm), but a relatively small skull (14.4 mm in length). Based on the known range of variation of this taxon (Table 1), this specimen could be confused with *L. egregius*; however, as highlighted by Lim et al. (1999), a diagnostic character useful to separate these species is the size of the lacrimal crest, reduced in *L. atratus* and well developed in *L. egregius*. This character is particularly useful when used in combination with other morphological differences such as coat color and cranial measurements. For example, Gardner and Handley (2008), Malaga et al. (2020), and Diaz et al. (2021) took into consideration dorsal and face coloration, as well as forearm size (45.5–47.0 mm), to identify *L. atratus*.

Lasiurus castaneus Handley, 1960

Figure 3

New record. BOLIVIA – Pando • 15 km NW of Puerto Camacho, Arroyo Hermoso; −11.2167, −067.7000; 195 elev.; 13.X.1991; R. J. Vargas leg.; habitat: secondary forest with patches of primary vegetation, with heavy rubber and chestnut extractive industry; 1 ♀ adult, CBF 1416 (Figure 3I–L).

Other material examined. PANAMA – Darien • Tacarcuna Village Camp.; 08.1500, −077.8333; 975 elev.; 06.III.1959; C.O. Handley Jr. leg.; holotype 1 ♀ adult, USNM 310263 (Figure 3A–D). COSTA RICA – Puntarenas • Estación de Campo San Gerardo; 10.3633, −084.7896; 1203 elev.; B. Rodríguez-Herrera, C. W. Dick, D. Villalobos-Chaves leg.; 2 ♂ adult, UCR 2538, 2539 (Figure 3E–G).

Identification. *Lasiurus castaneus* is a medium-sized bat with an average forearm length in males and females of 44.0 and 45.4 mm, respectively (Table 1). The dental formula is 1/3, 1/1, 2/2, 3/3 × 2 = 32. The dorsal fur is relatively long (~9 mm), dark brown, and tricolored, with a black base (~2 mm), amber middle band (2.5 mm), and dark brown tips (~4 mm); these three bands are equal in their extension (Figure 3B, F, J). The uropatagium has a bare distal quarter, while half of this membrane is covered by abundant chestnut-colored hairs that reach to cover the tibia (Figure 3C, G, K). The ventral fur is blackish brown with yellowish to whitish tips and a dark-brown base (Figure 3D, H, L). Hairs surrounding the white humeral spot are black tipped, and the wing membranes are entirely black (Figure 3A, E, I).

In terms of size, *L. castaneus* (FA <45 mm) is similar to *L. ega* (FA 43–51 mm) and *L. ebenus* (FA ~45 mm). In contrast, *L. castaneus* tends to be smaller than *L. atratus* (FA >45 mm), *L. arequipae* (FA >46 mm), *L. egregius* (FA >47 mm), and *L. villosissimus* (FA >50 mm), but larger than *L. blossevillii*, *L. frantzii*, and *L. varius* (FA <42 mm). Other qualitative and quantitative characters that allow identification of *L. castaneus* are shown in Table 2. The specimen of *L. castaneus* recorded for Bolivia (CBF 1416) is similar to specimens from Panama and Costa Rica, in addition to presenting the diagnostic characters indicated in the original description (Figure 3I, L).

Distribution. The description of *L. castaneus* (Handley, 1960) was based on a specimen from Panama (USNM 310263). Twenty-five years later, Dinerstein (1985) reported two specimens (one male and one female) from Costa Rica, the same country where the subsequent records were obtained (Villalobos-Chaves and Dick 2014; Málaga et al. 2020). Records by Villalobos-Chaves and Dick (2014), almost three decades after Dinerstein (1985), and by Málaga et al. (2020), also involved few specimens (two and one, respectively). Although *L. castaneus* has also been reported from Brazil (Gardner and Handley 2008), the specimens (Instituto Nacional de Pesquisa da Amazônia, INPA 2493, 2494) supporting this record could instead correspond to *Lasiurus blossevillii* or *L. frantzii*, as some measurements—most notably the forearm length (41.8–41.3 mm)—are within the range of variation of the latter two species (FA <42 mm), and are unlike the values recorded for *L. castaneus* (44.0–45.4 mm). The specimen from Bolivia reported here corresponds to the southernmost record of *L. castaneus* and extends the distribution range of this species by more than 2,000 km (Figure 2). Therefore, the entire hypodigm of *L. castaneus* is composed of seven specimens from

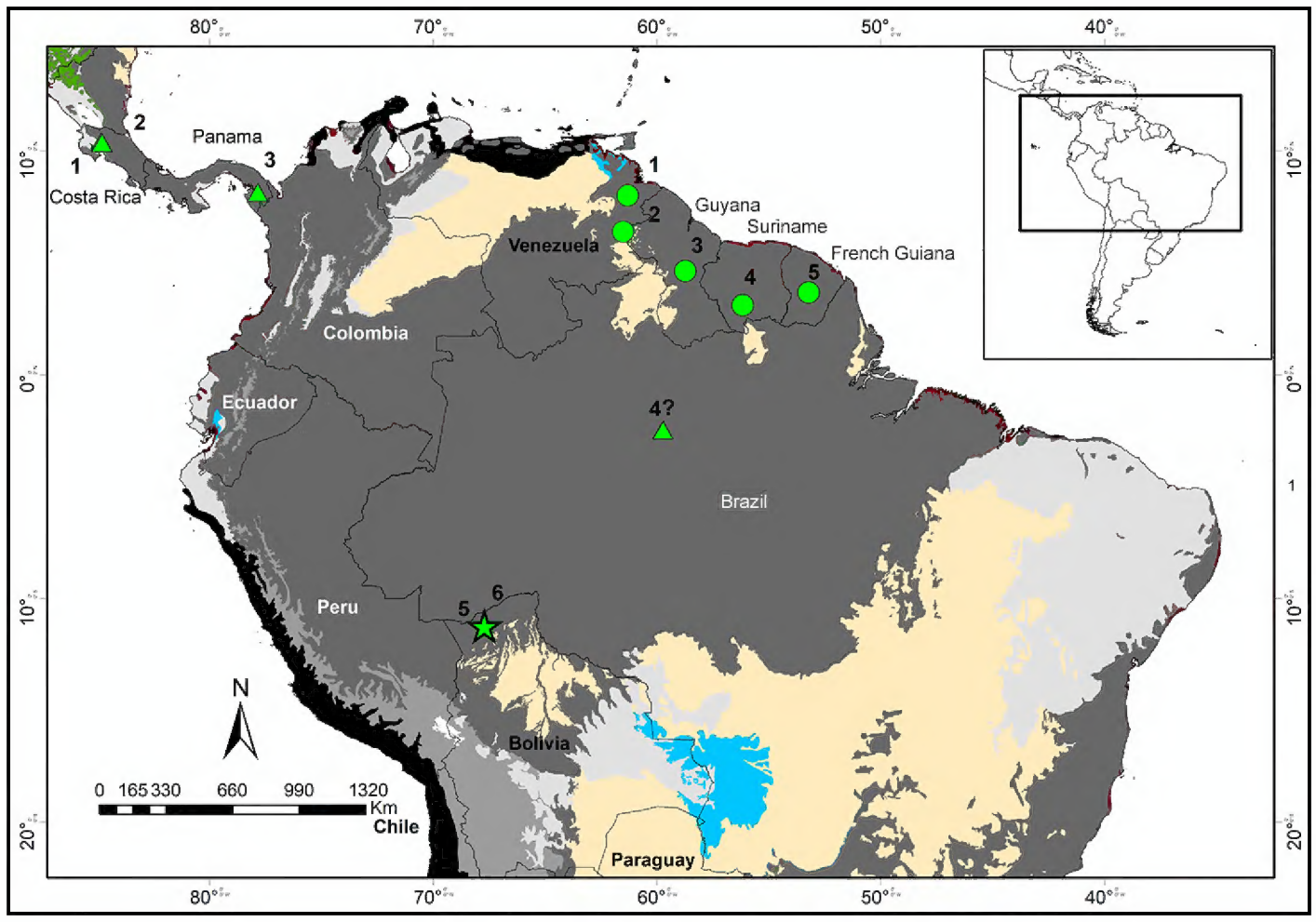

Figure 2. Geographic position of the localities previously known for *Lasiurus atratus* (green circles) and *L. castaneus* (green triangles), in addition to the first records for Bolivia reported in this study (green star). Sources of previous information: for *L. atratus*: 1–4 = Gardner and Handley (2008) and 5 = Masson and Cosson (1992); for *L. castaneus*: 1 = Villalobos-Chavez and Dick (2014), 2 = Dinerstein (1985), 3 = Moratelli (2008), and 4? = (doubtful record, see text in the distribution section of this species) Gardner and Handley (2008).

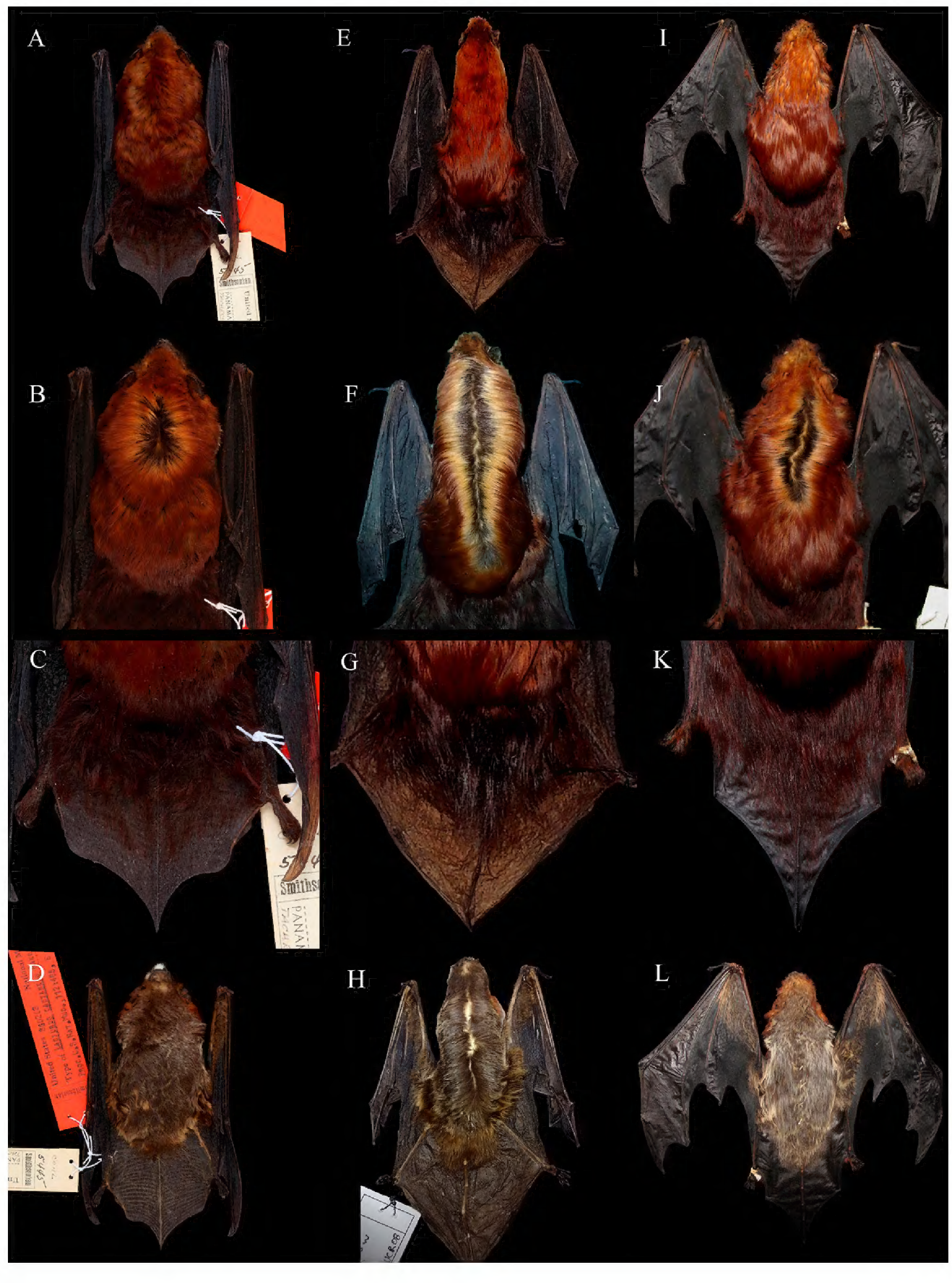

Figure 3. Dorsal and ventral views of specimens of *Lasiurus castaneus* from three countries. **A–D.** Panamá (Holotype, USNM 310263). **E–H.** Costa Rica (UCR 2538). **I–L.** Bolivia (CBF 1416). Note the chestnut color of the dorsal coat and the similarity in the proportions of the bands, as well as the bare distal quarter of the uropatagium and the yellowish-whitish ventral coat at the ends. All these characteristics were noted by Handley (1960) in the original description of this species.

Figure 4. Dorsal view of one specimen of *Lasiurus egregius* from Bolivia (CBF 1423; **A–C**), compared with *L. ega* (MNKM 2723; **D–F**). Note the differences in coloration of the dorsal pelage (including bands) and uropatagium.

three countries: Bolivia (*n* = 1), Costa Rica (*n* = 5), and Panama (*n* = 1). Here, we studied three specimens, including the holotype. Based on the data obtained from this series, we suggest that the length of the forearm, the brown color of the dorsal hair and the extension of the bands, together with the abundant hair on the uropatagium with a distal third of the uropatagium naked, constitute the best diagnostic characters to differentiate *L. castaneus* from other species of *Lasiurus*; the color of the ventral hair can vary from yellowish to whitish. Variation in the coloration of the ventral fur also occurs in *L. atratus* as noted by Handley (1996) based on specimens used in the original description of this taxon.

Lasiurus ega (Gervais, 1856)

Material examined. BOLIVIA – La Paz • Pilón Lajas, Rio Quiquibey, Asunción de Quiquibey; −14.6377, −067.6274; 259 elev.; 26.XI.1998; Aida Torrico leg.; 1 ♂ adult, MNKM 2723**.**

Lasiurus egregius (W. Peters, 1870)

Figure 4

New record. BOLIVIA – Pando • 15 km NW of Puerto Camacho, Arroyo Hermoso; −11.2167, −067.7000; 195 elev.; 13.X.1991; Luis Aguirre and Roberto de Urioste leg.; habitat: secondary forest with patches of primary vegetation, with heavy rubber and chestnut extractive industry; 1 ♂ adult, CBF 1423 (Figure 4A–C).

Identification. According to Carter and Dolan (1978) and Handley (1960, 1996), *L. egregius* is considered large, with an average forearm length of 48.7 and 49.2 mm, for females and males, respectively (Table 1). Dorsal coloration reddish; dorsal hairs with three bands (black, yellow, and reddish); uropatagium covered with short reddish hairs halfway down; wings blackish (Figure 4).

Figure 5. Dorsal, lateral, and anterior views of skulls of representative specimens of *Lasiurus egregius* (CBF 1423; **A**) and *L. ega* (MNKM 2723; **B**) from Bolivia. Note the differences in the arrangement of the supraorbital ridges, the development of the lacrimal crest and the angle of the coronoid process.

Lasiurus egregius is a relatively large bat (forearm length > 47 mm) and tends to be larger than *L. ega* (FA: 43–51 mm). Compared to other species of *Lasiurus*, *L. egregius* is larger than most species of South America (*L. arequipae*, *L. atratus*, *L. blossevillii*, *L. castaneus*, *L. ebenus*, *L. frantzii*, and *L. varius*), except when compared to *L. villosissimus*, which presents a FA >50 mm. Despite the similarity in size between some specimens of *L. egregius* and *L. ega*, the latter species can be easily differentiated by the yellowish color of the dorsal hairs. In both species the dorsal hairs have three bands, but in *L. ega* these bands are brown, yellowish brown, and yellowish, whereas in *L. egregius* they are black, yellow, and reddish (Table 2). Additionally, these species differ in the following characters: arrangement of the supraorbital ridges, development of the lacrimal crest, and angle of the coronoid process (Figure 5A, B). The specimen from Bolivia (CBF 1423) presents all diagnostic characters of *L. egregius* (Table 1, Figures 4, 5) and extends the range of the species 1,306 km northern from its nearest record in Brazil (Figure 6).

DISCUSSION

The finding of *Lasiurus atratus*, *L. castaneus*, and *L. egregius* in Bolivia increases the known richness of bats of the genus in this country to six species (*L. atratus*, *L. blossevillii*, *L. castaneus*, *L ega*, *L. egregius*,

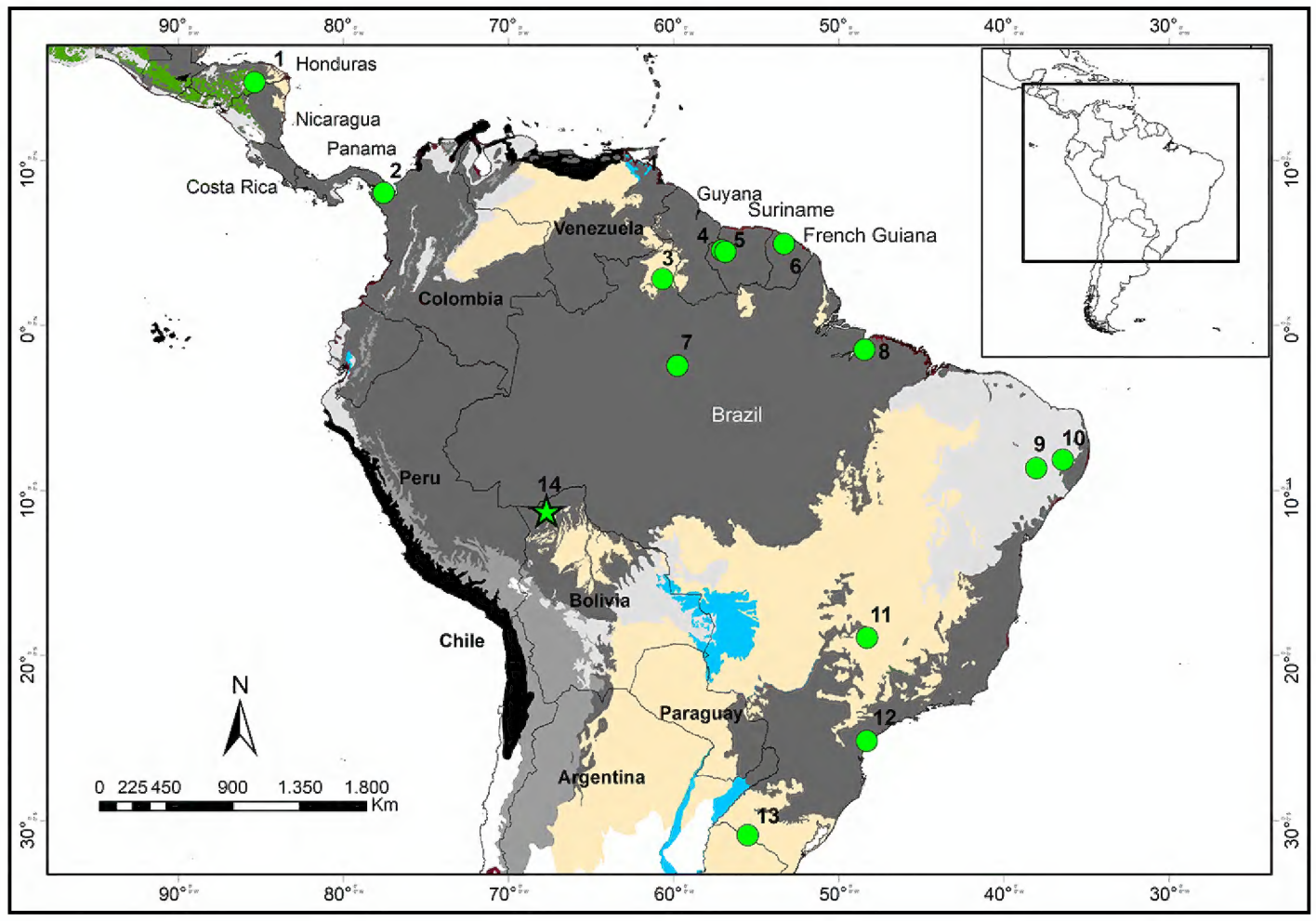

Figure 6. Geographic position of the localities previously known for *Lasiurus egregius* (green circles) and the first record for Bolivia reported in this study (green star). Sources of previous information are as follows: 1 (Mora 2012), 2 (Handley 1960), 3 (Capaverde-Junior et al. 2014), 4-5 (Lim 2009), 6 (Williams et al. 1990), 7 (Lopez-Baucells et al. 2014), 8 (Kalko and Handley 2001), 9 (Sousa et al. 2004), 10 (Silva and Marinho-Filho 2010), 11 (Stutz et al. 2004), 12 (Carvalho et al. 2019) and 13 (Giménez and Giannini 2011).

and *L. villosissimus*). In addition, the specimens reviewed represent the first records for the southwestern sector of the Amazon region, with a significant extension of their distributions of around 2,015 km, 2,400 km, and 1,306 km, respectively. Previously, *L. atratus* was known from a relatively restricted area in the Guiana region of Venezuela, Guyana, Suriname, and French Guiana (Gardner and Handley 2008; Moratelli et al. 2019a; Ochoa 2000; Ochoa et al. 2008a). Similarly, *L. castaneus* had been reported from few localities in southern Central America: Costa Rica and eastern Panama (Handley 1960; Villalobos-Chaves and Dick 2014), with only one controversial record from South America in Brazil (Gardner and Handley 2008; Figure 2). *Lasiurus egregius* has been collected in Panama, Honduras, French Guiana, and Brazil, where it appears to be a rare component of bat communities (Gardner and Handley 2008; Carvalho et al. 2019) or a cryptic species difficult to detect with conventional sampling methods (Jung et al. 2014; Schnitzler and Kalko 2001). Using acoustic calls, however, the species has been categorized as common by López-Baucells et al. (2014).

The presence of the three species recorded here for the first time in Bolivia was unexpected in a biogeographic context. As suggested by Simmons and Voss (1998), bat faunal similarity within the Neotropical rainforest biomes is positively correlated with geographic proximity. In the case of *L. atratus* and *L. castaneus*, these bats were recorded previously only in rainforests of the Guiana subregion, or in southern Central America, respectively (e.g. Voss and Emmons 1996; Villalobos-Chaves and Dick 2014). Therefore, it is important to evaluate the reasons for the lack of records in well-sampled localities in southwestern Amazon (e.g. Jenaro Herrera, Cocha Cashu/Pakitza; see Voss and Emmons 1996). In this context, it would be worthwhile to compare the distribution patterns of these three taxa with the biogeographic trends observed in other bat species.

Aerial insectivorous bats are difficult to sample with ground–level mist nets, the most common sampling method used in the Neotropics (Barnett et al. 2006), because they usually forage in medium to high strata inside the forests or in open areas (MacSwiney et al. 2008; Ochoa et al. 2000; Zamora-Gutierrez et al. 2019). Phyllostomids, on the other hand, frequently use the understory level for their flights, a behavior that favors their sampling by this method (Jung et al. 2014). At least partially due to this bias in capture rates, an important number of species are often not well represented in bat inventories and zoological collections (e.g. *Diclidurus* spp., *Peropteryx kappleri*, *Lasiurus* spp., and species of Molossidae; Miller et al. 2023). The development of more exhaustive field surveys, as well as the use of alternative methods for the recording of insectivorous species (including acoustic detection), represent important options to the efforts oriented to increase the knowledge of Lasiurini members and other groups of bats inhabiting poorly explored areas (Miller et al. 2023). The use of these complementary methods for bat samplings may help to understand if the rarity of some species is an artifact of traditional collecting (Ochoa et al. 2000, 2008b).

We highlight that the reviewed specimens of *Lasiurus atratus*, *L. castaneus*, and *L. egregius* reported here were collected at the same locality and on the same day (13-X-1991). Considering that these taxa are scarcely represented in zoological collections, their capture is an exceptional situation in bat surveys, even when these surveys are conducted in regions such as the Amazon, highly diverse for this group (Lim and Engstrom 2001; Sampaio et al. 2003; Velazco et al. 2021) and where important efforts to inventory bats have been conducted (Parker and Bailey 1991; Reitz-Montambault 2002). At the time of the collection of the specimens reported here, the vegetation cover consisted of a mosaic of primary and secondary forests affected by extractive activities (Aguirre and de Urioste 1994). The extraction of natural resources for

commercial or industrial purposes started in the early 1990s, implying the existence of threats to the conservation of these ecosystems and their associated fauna. The evaluation of this and other areas, as well as the identification of their conservation needs, should be a priority for the Bolivian government.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare [or author declares] that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Conceptualization: JSB, JLPU, LHAS, KBM, JOG, KR. Methodology: LAS, JPU, KBM, KR. Investigation: LAS, JPU, KBM, JOG, JSB. Formal analysis: LAS, JPU, KBM, JOG, JSB. Visualization: LAS, JPU, KBM, KR, JOG, JSB. Writing – original draft: LAS, JPU, KBM, KR, JOG, JSB. Writing – review and editing: LAS, JPU, KBM, KR, JOG, JSB.

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Data availability

All data that support the findings of this study are available in the main text.

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